



**U.S. Environmental Protection
Agency Region 7**

**Honey Creek
Henry County, Missouri**

Total Maximum Daily Load

August, 2006

Approved by:

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Director

Water, Wetlands, and Pesticides Division

08/17/06
Date

**Total Maximum Daily Load (TMDL)
For Honey Creek
Pollutant: Sulfate**

Name: Honey Creek

Location: Near Clinton in Henry County, Missouri

Hydrologic Unit Code (HUC): 10290108-150001

Water Body Identification (WBID): 1251

Missouri Stream Classification: C¹

Beneficial Uses²:

- Livestock and Wildlife Watering
- Protection of Warm Water Aquatic Life
- Protection of Human Health associated with Fish Consumption

Size of Impaired Segment: 3.0 miles

Location of Impaired Segment: From (upstream) NE ¼, Section 11, T42N, R27W to (downstream) SW ¼, Section 10, T42N, R27W

Pollutant Source: Reliance Shop Abandoned Mine Lands

Pollutant: Sulfate

TMDL Priority Ranking: Medium

1. Introduction

This Honey Creek Total Maximum Daily Load (TMDL) for sulfate is being established in accordance with Section 303(d) of the Clean Water Act, because this waterbody is on the Missouri 1998 303(d) list of impaired waters because the water quality standards (WQS) for Honey Creek were exceeded due to sulfate. The Missouri Department of Natural Resources' (MDNR) Water Protection Program developed and public noticed documentation that Honey Creek is meeting WQS using the same data and analysis that is used in this TMDL. To meet the milestones of the 2001 Consent Decree, *American Canoe Association, et al. v. EPA*, No. 98-1195-CV-W in consolidation with No. 98-4282-CV-W, February 27, 2001, EPA is establishing this TMDL.

¹ Class C streams may cease to flow in dry periods but maintain permanent pools that support aquatic life. See Missouri Water Quality Standards (WQS) 10 Code of State Regulations 20-7.031(1)(F). The WQS can be found at the following uniform resource locator (URL): <http://www.dnr.mo.gov/env/wpp/rules/index.html#Chap7>

² For Beneficial uses see 10 CSR 20-7.031(1)(C) and Table (H)



The purpose of a TMDL is to determine the pollutant loading a waterbody can assimilate without exceeding the WQS for that pollutant. The TMDL also establishes the pollutant load allocation necessary to meet the WQS established for each waterbody based on the relationship between pollutant sources and in-stream water quality conditions. The TMDL consists of a wasteload allocation (WLA), a load allocation (LA), and margin of safety (MOS). The WLA is the fraction of the total pollutant load apportioned to point sources. The LA is the fraction of the total pollutant load apportioned to nonpoint sources. The MOS is a percentage of the TMDL that accounts for the uncertainty associated with the model assumption and data inadequacies.

2. Background and Water Quality Problems

2.1 Physical Characteristics of Basin

Henry County is located in west central Missouri and is an upland prairie area with gently sloping to steep topography. Streams generally flow from the higher relief in the northwestern part of the county to the lower relief in the southeastern part. Honey Creek and its tributaries flow into Big Creek about one mile upstream of where Big Creek joins the South Grand River. Rainfall averages about 39 inches with much of the precipitation occurring during the growing season. The impacted area is extensive due to the disruption of the watershed as a result of strip-mining activity, and it is impossible at this point to determine what exact soil types are represented. The Henry County Soil Survey designates the mined areas on their soils maps as "Mine pits and dumps" and describes them as "...steep, irregularly shaped dumps are a mixture of shale, sandstone, and the original mantle of soil stripped from the coal beds." It concludes that these areas' "response to management is poor."³ Use of these areas is restricted to grazing, woodland or wildlife habitat.

2.2 Land Use Information in Basin

Uplands in the Honey Creek basin are primarily of the Hartwell-Deepwater soil association. These are deep, nearly level to moderately sloping soils. They range from poorly drained to well drained soils formed in thin loess with the underlying minerals derived from acidic shale. Native vegetation is tall grasses; however, these soils are also suited to row crop agriculture and hay production.

Honey Creek is a small Missouri tributary of Big Creek. Honey Creek flows southwest into Big Creek north of Big Creeks' confluence with the South Grand River. The total watershed is about 48 square miles.

Areas along Honey Creek were strip-mined for coal in the 1940s and 1950s, ending in 1958. It was listed on the 1998 303(d) list for sulfate impairment from the Reliance Shop Abandoned Mine Land (AML) area. Honey Creek was placed on the 303(d) list due to a few water quality measurements showing high levels of conductivity, which is a measure of the

³ Soil Survey of Henry County, United States Department of Agriculture Soil Conservation Service, 1976, page 40.

amount of dissolved substances. Conductivity strongly correlates with the amount of sulfate and chloride in solution. The Missouri WQS for dissolved substances is 1,000 milligrams per liter (mg/L) of sulfate plus chloride. Levels of chloride in Missouri streams are typically much less than 100 mg/L so most dissolved substances problems are related to high levels of sulfate.

The Missouri Department of Natural Resources' Land Reclamation Program, reclaimed several areas along Honey Creek in the 1980s and 1990s. These included the Nannemann project on 60 acres, completed in 1986, at a cost of \$687,757, the Reliance Shop project on 72 acres at a cost of \$585,447, and the Honey Creek project on 32 acres at a cost of \$654,796. Slurry pits were filled, spoil piles and dangerous "highwalls" were graded and revegetated and the creek was returned to its original channel and cleaned of eroded fine sediment.

Results of water quality monitoring on Honey Creek since the completion of these reclamation projects are shown in Appendix B. When the draft 2002 303(d) list was produced, 2 sulfate observations had been recorded at the sample site (see map in Appendix A) within the impaired segment. Since then, the department has obtained four additional years of water quality data on Honey Creek. Thirteen sulfate observations have been recorded. To ensure that water quality is being maintained and protected in Honey Creek, water quality monitoring will continue (see Honey Creek data in Appendix B).

3. Description of the Applicable Water Quality Standards and Numeric Water Quality Targets

Beneficial Uses:

The designated uses of Honey Creek, WBID 1251, are listed on page 1. The designated uses and stream classifications may be found at 10 CSR 20-7.031(1)(C) and (F) and in Table H.

Use that is impaired:

Protection of Warm Water Aquatic Life

Anti-degradation Policy:

Missouri's WQS include the U.S. Environmental Protection Agency's (EPA) "three-tiered" approach to anti-degradation, and may be found at 10 CSR 20-7.031(2).

Tier 1 – Protects existing uses and provides the absolute floor of water quality for all waters of the United States. Existing instream water uses are those uses that were attained on or after November 29, 1975, the date of EPA's first WQS Regulation, or uses for which existing water quality is suitable unless prevented by physical problems such as substrate or flow.

Tier 2 – Protects the level of water quality necessary to support propagation of fish, shellfish, and wildlife and recreation in and on the water in waters that are currently of higher quality than required to support these uses. Before water quality in Tier 2 waters can be lowered, there must be an anti-degradation review consisting of: (1) a finding that it is necessary to accommodate

important economical or social development in the area where the waters are located; (2) full satisfaction of all intergovernmental coordination and public participation provisions; and (3) assurance that the highest statutory and regulatory requirements for point sources and best management practices for nonpoint sources are achieved. Furthermore, water quality may not be lowered to less than the level necessary to fully protect the “fishable/swimmable” uses and other existing uses.

Tier 3 – Protects the quality of outstanding national resources, such as waters of national and state parks, wildlife refuges and waters of exceptional recreational or ecological significance. There may be no new or increased discharges to these waters and no new or increased discharges to tributaries of these waters that would result in lower water quality (with the exception of some limited activities that result in temporary and short-term changes in water quality).

Specific Criteria:

The impairment of this waterbody is based on exceedence of the specific criteria contained in Missouri’s WQS, 10 CSR20-7.031(4)(L)1, which only concerns streams with 7Q10 low flow of less than one cubic foot per second (cfs). There it states that the concentration of chloride plus sulfate (SO₄ + Cl) shall not exceed 1000 mg/L for protection of aquatic life.

4. Calculation of Load Capacity

The Loading Capacity (LC) is the greatest amount of pollutant loading that a stream can assimilate without becoming impaired. It is equal to the sum of the Load Allocation (LA), the Wasteload Allocation (WLA) and the Margin of Safety (MOS) and can be expressed as an equation:

$$LC = LA + WLA + MOS$$

Dry weather design flow from the Honey Creek AML can not be accurately determined because surface flow and seepage rates from this area are variable. Honey Creek is a Class C stream, which ceases to flow in dry periods but maintains permanent pools that support aquatic life. Dry weather design flow is therefore 0.1 cubic feet per second (cfs) or less. Since there can be minimal upstream dilution during dry weather conditions, the flow of water coming from the Honey Creek AML area will have to meet in-stream WQS for sulfate plus chloride. For sulfate, load capacity is the combined sulfate plus chloride standard of 1000 mg/L. Using the numeric water quality target and margin of safety, an in-stream sulfate plus chloride target of 900 mg/L should ensure that WQS are met and maintained in Honey Creek. A margin of safety of 100 mg/L or ten percent (10%) would ensure combined sulfate and chloride totals on Honey Creek would remain below 1000 mg/L.

The paucity of specific instream data does not allow for the generation of a site-specific TMDL curve and a generalized ecological drainage unit evaluation was therefore used, as shown in the Figure 1 on the next page:

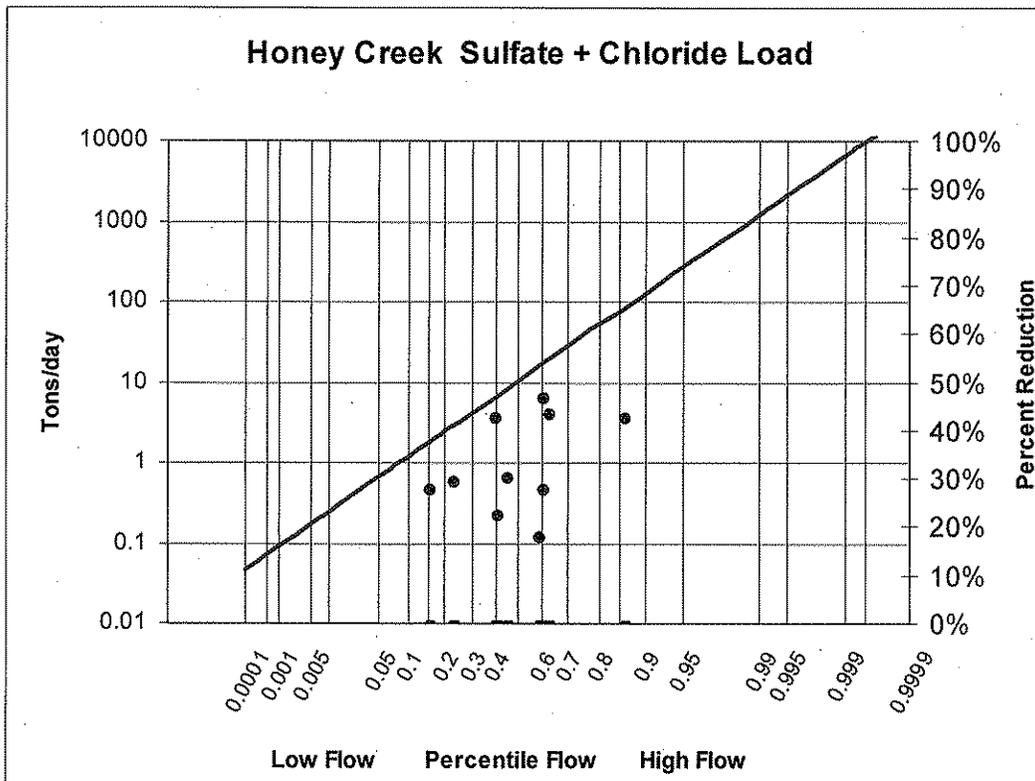


Figure 1 -- TMDL curve over the range of flows.

For a full description of the Development of Pollutant Targets using Reference Load Duration Curves, please refer to Appendix D.

5. Load Allocation (Nonpoint Source Loads)

LA is the allowable amount of the pollutant that can be assigned to nonpoint sources. **Sulfate** --Using the numeric water quality target and margin of safety, an instream sulfate plus chloride target of 900 mg/L should ensure that water quality standards are met and maintained in Honey Creek. The LA is set at 90% of the TMDL curve as shown in Figure 1, for example, at the flow probability of 0.7, the TMDL is about 20 tons per day. The LA would therefore be 18 tons per day.

6. Waste Load Allocation (Point Source Loads)

The Wasteload Allocation is the maximum allowable amount of the pollutant that can be assigned to point sources. There are presently no point sources discharging to the affected segments of Honey Creek. Any future discharges would be required by Missouri State Operating Permit (per the EPA NPDES permit) to maintain a concentration of chloride plus sulfate of 900 mg/L or less. Because there are no sources, the WLA is zero for this TMDL.

7. Margin of Safety

A MOS is usually added to a TMDL, if a TMDL is necessary, to account for the uncertainties inherent in the calculations and data gathering. The MOS is intended to account for such uncertainties in a conservative manner. Based on EPA guidance, the MOS can be achieved through one of two approaches:

(1) Explicit – Reserve a numeric portion of the loading capacity as a separate term in the TMDL.

(2) Implicit – Incorporate the MOS as part of the critical conditions for the waste load allocation and the load allocation calculations by making conservative assumptions in the analysis.

The MOS in this case is explicit.

Sulfate

No other significant sulfate plus chloride sources exist within the watershed, therefore a MOS equal to a ten percent reduction (10%) or 100 mg/L (SO₄ + Cl) of the loading capacity has been selected. If future in-stream monitoring indicates applicable WQS are exceeded, the TMDL will be reopened.

8. Seasonal Variation

The water quality data collected to this point represents all seasons. The TMDL curve represents flows under all seasonal conditions. The primary processes involved in loading large amounts of dissolved substances (like salts or sulfate minerals) in the water is not significantly affected by differences in air and water temperatures associated with seasonal change. Missouri standards do not distinguish between summer and winter for sulfate and chloride.

9. Monitoring Plans for Honey Creek

Yearly monitoring by MDNR will be discontinued based on MDNR's assessment of the data, observing that from 2000 through April 7, 2006, data has been consistently within WQS (with one exception). MDNR plans in approximately three years to check the stream again to make sure the reclamation work has not deteriorated. Parameters monitored are pH, sulfate, chloride, conductivity, dissolved oxygen and temperature.

10. Public Participation

EPA regulations, 40 CFR 130.7, require that TMDLs be subject to public review. EPA is providing public notice of this draft TMDL for Honey Creek on the EPA, Region 7, TMDL website: <http://www.epa.gov/region07/water/tmdl.htm>. The response to comments and final TMDL will be available at: http://www.epa.gov/region07/water/tmdl_public_notice.htm.

This water quality limited segment of Honey Creek is included on the approved 1998 and 2002 303(d) list for Missouri. As stated before, MDNR's The Missouri Department of Natural Resources' Water Protection Program developed and public noticed documentation that Honey Creek in Henry County, Missouri, is meeting WQS using much of the same data and analysis that is used in this TMDL. This TMDL is being produced by EPA as part of the 2001 Consent Decree, *American Canoe Association, et al. v. EPA*, No. 98-1195-CV-W in consolidation with No. 98-4282-CV-W, February 27, 2001. EPA is developing this TMDL in cooperation with the State of Missouri, and EPA is establishing this TMDL at this time to fulfill the *American Canoe* consent decree obligations. Missouri may submit and EPA may approve another TMDL for this water at a later time.

When MDNR public noticed this waterbody as meeting WQS, the public notice period was from January 13, 2006, to February 12, 2006. A presentation on the Honey Creek TMDL was given April 4, 2002 to the Henry County Soil Conservation District Board. As part of the public notice process, EPA and MDNR maintained an email mailing list of interested persons to provide notification of issues relating to the Honey Creek TMDL. Groups that received the public notice announcement included the Missouri Clean Water Commission, Henry County Soil and Water Conservation District, the Missouri Water Quality Coordinating Committee, Stream Team volunteers in the county and the legislators representing Henry County. Comments received by MDNR on it's public notice and the responses are maintained in MDNR's administrative files. The EPA public noticed this TMDL from June 28, 2006 to July 30, 2006, and the Summary of Response to Comment(s) is posted on the EPA website: <http://www.epa.gov/region07/water/apprtmtdl.htm#Missouri>.

11. Appendices

Appendices:

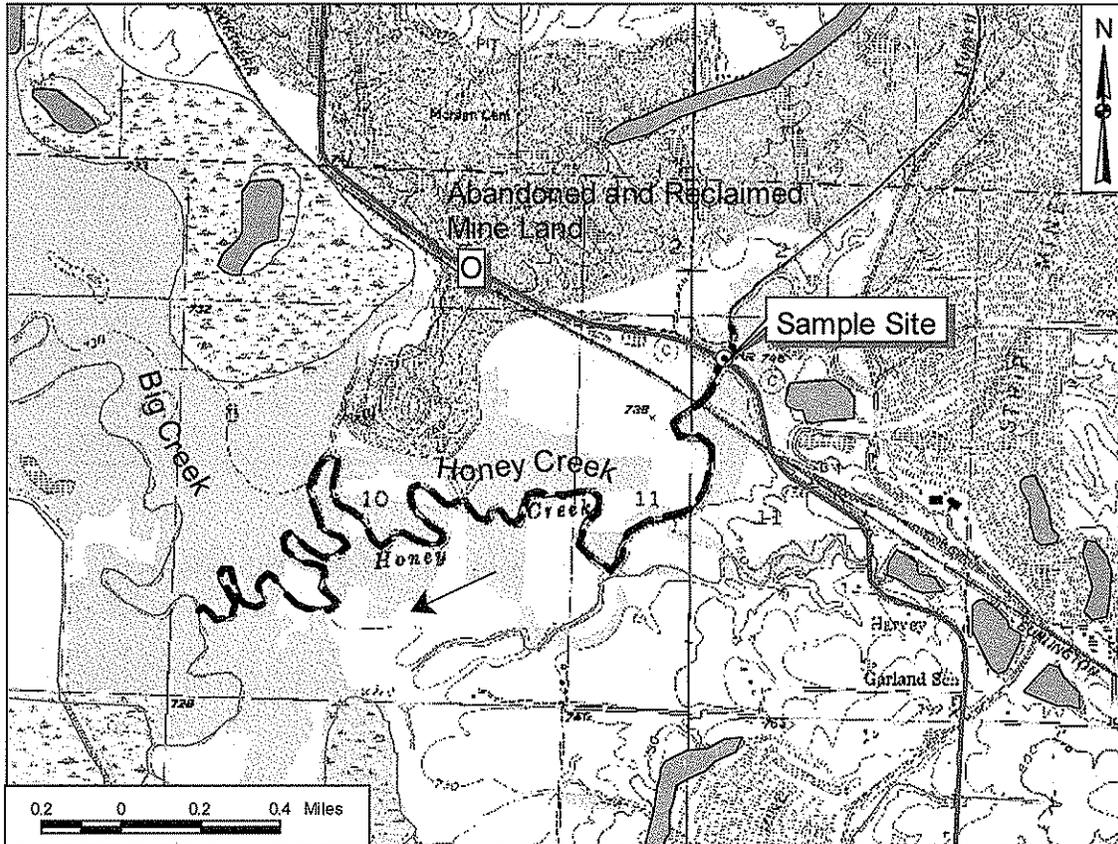
- Appendix A – Topographic map of the Honey Creek, impaired segment and sampling site
- Appendix B – Data for Honey Creek
- Appendix C – Total Maximum Daily Load Information Sheet for Honey Creek
- Appendix D – Load Duration Methodology

Basin Water Quality Studies:

- Evaluation of the Recovery of Fish and Invertebrate Communities Following Reclamation of a Watershed Impacted by an Abandoned Coal Surface Mine. By James F. Fairchild, Barry C. Poulton, Thomas W. May, and Stuart M. Miller, http://toxics.usgs.gov/pubs/wri99-4018/Volume1/sectionD/1501_Fairchild/pdf/1501_Fairchild.pdf
- Office of Surface Mining Annual Evaluation Summary Report for the Regulatory and Abandoned Mined Land Programs Administered by the Land Reclamation Program of Missouri for Evaluation Year 1998 (October 1, 1997 to September 30, 1998) November 1998 <http://www.osmre.gov/missouri98.htm>

Appendix A

Map Showing Sampling Site on Honey Creek, Henry County, Missouri



Appendix B

Water Quality Data from Honey Creek at Hwy O, Henry County

Site Name	Year	Month	Day	SC	SO4	Cl	SO4+Cl
Honey Cr. at Hwy O	1997	7		1552	646	9	655
Honey Cr. at Hwy O	2000	8	4	775	260	10	270
Honey Cr. at Hwy O	2003	7	29	972	286	14	300
Honey Cr. at Hwy O	2003	12	30	522	119	13	132
Honey Cr. at Hwy O	2004	8	13		255	13	268
Honey Cr. at Hwy O	2004	9	29	770	216	13	229
Honey Cr. at Hwy O	2005	2	3	845	251	15	266
Honey Cr. at Hwy O	2005	3	16	887	254	16	270
Honey Cr. at Hwy O	2005	5	19	948	298	17	315
Honey Cr. at Hwy O	2005	7	20	1031	333	14	347
Honey Cr. at Hwy O	2005	8	12	1091	362	14	376
Honey Cr. at Hwy O	2006	2	2	2330	1370	6	1376
Honey Cr. at Hwy O	2006	4	7	1290			
Mean:				1084	388	13	400
Water Quality Standard							1000

Note: SO4 = Sulfate; Cl = Chloride

Honey Creek was originally placed on 303(d) list due to high conductivity values.

Appendix C
Total Maximum Daily Load Information Sheet for Honey Creek

This document is provided as link in electronic copies and will be included as a hard copy appendix
in hard copy distributions of this TMDL.

<http://www.dnr.mo.gov/env/wpp/tmdl/info/honey-ck-info.pdf>

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Appendix D

Development of Pollutant Targets using Load Duration Curves for Drainage Areas Less Than 100 square Miles

Overview

This procedure is used where a lotic system is placed on the 303(d) impaired waterbody list for a pollutant with a numeric standard and the designated use being addressed is aquatic life. With small drainage areas it is unlikely a flow record for the impaired stream is available. If this is the case a synthetic flow record is needed. In order to develop a synthetic flow record we calculate an average of the log discharge per square mile of USGS gaged rivers for which the drainage area is entirely contained within the aquatic subregion. From this synthetic record we develop a flow duration from which to build a load duration curve for the pollutant within the subregion. Using a relationship between drainage area and the percentile at which flow is at 0.01 cubic feet per second (cfs) the load duration curve is modified to fit the conditions of the specific impaired stream.

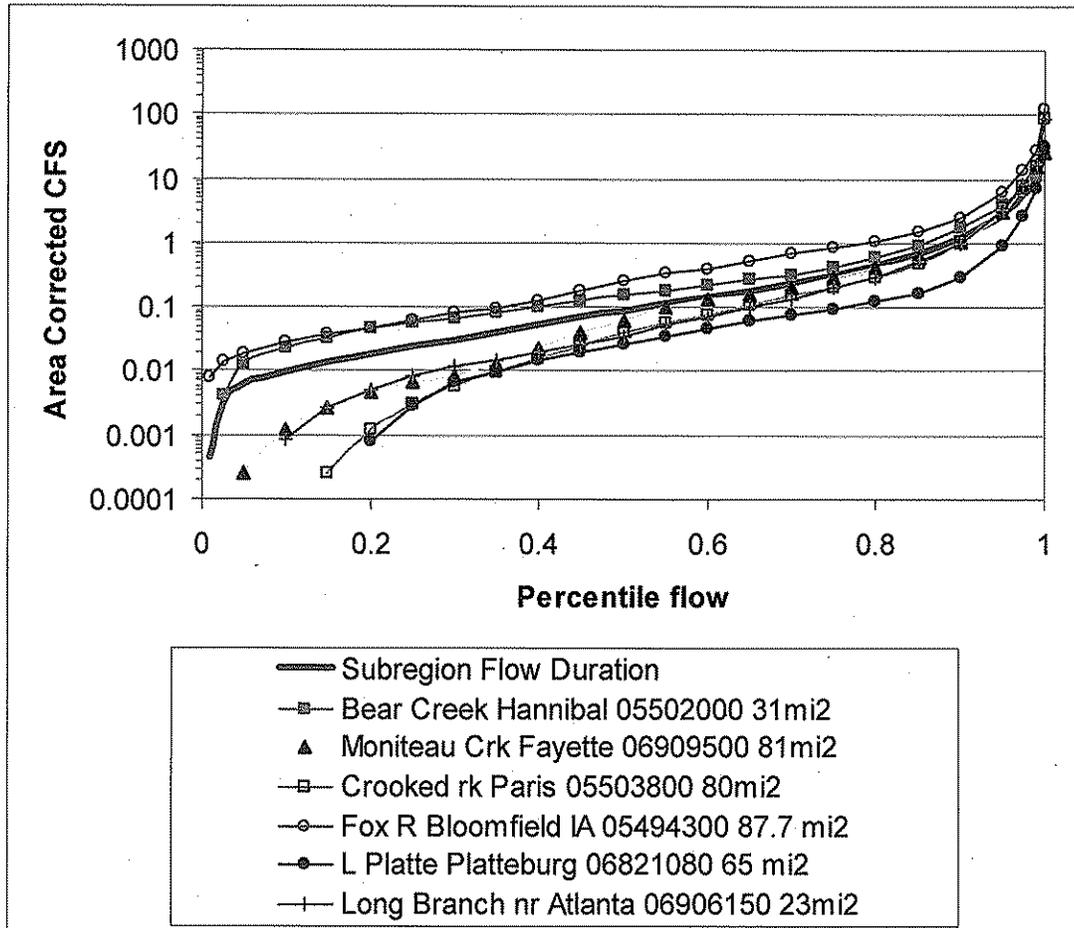
Methodology

The first step in this procedure is to locate available pollutant data within the EDU of interest. These data along with the instantaneous flow measurement taken at the time of sample collection for the specific date are recorded to create the population from which to develop the load duration. Both the date and pollutant concentration are needed in order to match the measured data to the synthetic subregion flow record.

Secondly, collect average daily flow data for gages with a variety of drainage areas of less than 90 square miles for a period of time to cover the pollutant record. From these flow records normalize the flow to a per square mile basis. Average the log transformations of the average daily discharge for each day in the period of record. For each gage record used to build this synthetic flow record calculate the Nash-Sutcliffe statistic to determine if the relationship is valid for each record. This relationship must be valid in order to use this methodology. This new synthetic record of flow per square mile is used to develop the load duration for the aquatic subregion. The flow record should be of sufficient length to be able to calculate percentiles of flow.

The following examples show the application of the approach to one Missouri aquatic subregion.

The watershed-size normalized data for the individual gages in the subregion were calculated and compared to a pooled data set including all of the gages. The results of this analyses is displayed in the following figure and table:

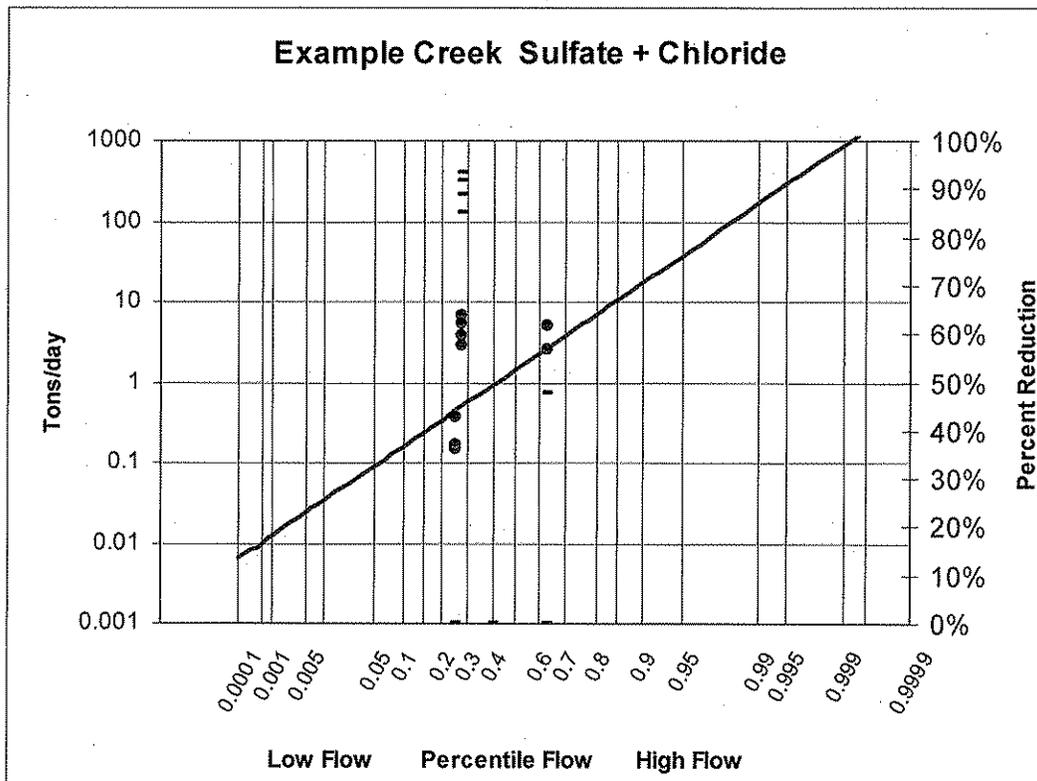


Gage	gage	area (mi ²)	lognormal Nash-Sutcliffe
Bear Creek	05502000	31	90%
Moniteau Creek	06909500	81	85%
Crooked Creek	05503800	80	62%
Fox River	05494300	87.7	46%
L Platte R	06821080	65	98%
Long Branch	06906150	23	62%

This demonstrates the pooled data set can confidently be used as a surrogate for the subregion analyses.

The next step is to calculate pollutant-discharge relationships for the subregion, these are log transformed data for the yield (tons/mi²/day) and the instantaneous flow (cfs/mi²). The load duration curve (TMDL) is derived using the flow at each percentile and the numeric water quality standard. The measured data points are plotted on this graphical relationship to develop the model.

The resulting TMDL of all data in the watershed is shown in the following graph. In this example a vertical red line marks the point at which the stream flow for the specific stream goes below 0.01 cfs. This point is calculated by the general relationship of percentile and drainage area. At percentiles below this there is no load because the stream has no flow. Data points in this range indicate concentrations in isolated pools in the stream.



To apply this process to a specific watershed would entail using the individual watershed data compared to the above TMDL curve that has been multiplied by the watershed area.

For more information contact:
 Environmental Protection Agency, Region 7
 Water, Wetlands, and Pesticides Division
 Total Maximum Daily Load Program
 901 North 5th Street
 Kansas City, Kansas 66101
 Website: <http://www.epa.gov/region07/water/tmdl.htm>

